INVESTMENTS in TOMORROW

No. 14 Winter 1975

Window to the Office of the Future

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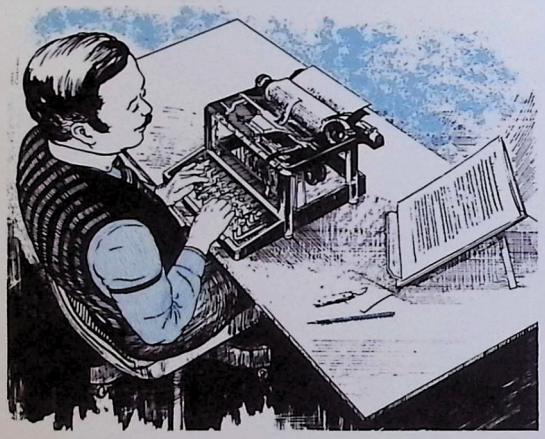
Typewriter with memory paves way fo



The office typewriter, first introduced by E. Remington & Sons, Gunmakers, about 100 years ago, gained such rapid acceptance that by the turn of the century most of the clerks who had been copying documents by hand were typing them or had been replaced by others who were doing so.

Now, as we enter the last quarter of this century, the office world seems to be on the verge of a second and equivalent period of "future shock," based on the computer and spearheaded by the word processing typewriter (bottom photo).

For a few, the computerized office is old hat. They can do things like send instant messages to remote colleagues by computer terminal. Or consult a library housed in a computer across the country. Or read the mail that has stacked up for them back at the office from a portable terminal in their hotel room. They use computers routinely to sort their mail, help them compose documents and look up citations for them.

But these people work under very special circumstances. Many, for example, work for Department of Defense (DoD) contractors and have access to the ARPANET, which was built under the sponsorship of the Advanced Research Projects Agency (ARPA) of the DoD and interconnects computers all over the world into a single network. (See p. 5 for details.)

For the average worker, the office environment has changed little since the days when the ideal "typewriter" measured 36-26-36 and had blue eyes. On a business trip, the executive still has to phone his secretary and have her read or send his office mail to him via the U.S. mails. And the typists still type letters by hand, make corrections on the typed copy, put the letters into envelopes and drop the envelopes into the mail slot.

More important, since 1900, the cost of typists' labor has increased much more rapidly than has their productivity. Yet equipment that might increase this productivity has only recently begun to gain acceptance in the traditional office environment.

The typewriter, in particular, is such an integral part of the way people do their work in offices that changes in its look, feel or other characteristics are resisted. Computer keyboards, for example, have not replaced or even threatened the typewriter, although they are generally quieter and at least potentially faster.

But the electronic revolution is coming to the office just as it has already come to the accounting department, the news room, the stock exchange and the airline reservation counter. In many commercial offices, new equipment has already changed the boss' relationship with his secretary and the way secretaries do their work. In a few years, the computer may make even more profound changes in the working habits of the boss himself. (See pp. 6-10 for details.)

Paving the way for this computer takeover is the so-called "word processing" typewriter. First introduced by IBM in 1964, this machine is much like a standard IBM Selectric typewriter. It has two added capabilities, however, that greatly increase the typist's potential productivity — but at the cost of changing her procedures and those of the executives she serves.

An intelligent typewriter

These capabilities, for which the user pays anywhere from $5,000 to $15,000 more than for a standard Selectric, are memory — usually in the form of magnetic cards or tape — and logic circuitry.

Together these capabilities allow the machine to translate the typist's keystrokes into machine-readable form, record this material in memory and manipulate it in various ways to yield something, such as corrected pages.

The keyboard is standard, but typing on it produces not only a paper copy but also a magnetic recording that can be automatically searched and selectively edited. When all the changes have been made on the magnetic recording, the typist feeds it through the typewriter, producing a clean paper copy at full speed for the typewriter. This not only saves the time required for manual retyping — which may have to be done several times during the course of preparing a long document — but also eliminates the risk of introducing new errors in unchanged text during retyping.

It also minimizes the chances that a document will fail to pass the final review step. Tom Humphrey, a senior research engineer who has conducted extensive studies of large document-processing systems, including SRI's, estimates that in a typical manual system, up to 25 percent of the documents reviewed after final typing are returned to some earlier stage of production, often at greatly added cost. Apparently either the originator gets cold feet when he sees the document for the first time as intended recipients will see it, or else the entire process has taken so long that new information has become available.

With the automatic retyping capability, the percentage of rejects at the final production stage is cut down to 10 to 15 percent, Humphrey says. Such a system allows the originator to see the document in closer to final form earlier in the process and to work with clean copy at every step of the operation. It also shortens the production cycle so that new information is less likely to become available before the document is completed.

Another advantage of the word processor is that it facilitates the formation of a central library for standard passages or "boiler plate" that can be reused many times. Once such boiler plate has been recorded on magnetic cards or tape, it can easily be added to the library. When a text originator needs a similar passage, he merely dictates the standard passage number and the desired changes. The typist then locates the tape or card containing the passage and feeds it through her word processing typewriter, keyboarding only the changes.

Alan Purchase, a senior industrial economist who has just completed a two-year multiclient study of office equipment, says that this capability of repetitive typing was the feature of the word processing typewriter that particularly attracted its first users — largely such firms as insurance companies and law offices that make heavy use of boiler plate. But more and more, he says, companies are buying the machine for its text editing capabilities. He points out that two word processors, effectively used, can do the work of three or more standard typewriters. According to Humphrey, users who replace standard electric typewriters with word processors report typical savings of $1 to $2 per final printed page.

The word processor is expensive, however, and to achieve these savings, office procedures have to be changed so that the equipment can be fully utilized. As a result, most users have formed special word processing groups to handle the work of several originators. Because of their greater productivity, the secretaries specialize either as full-time typists or as administrative support personnel. The originators deal with each secretary according to her specialty, often dictating to a machine. A typical procedure is to dictate by telephone directly to dictation equipment in the word processing center.

Private secretary disappears

Although the originators may miss the convenience and prestige of having a private secretary, this arrangement offers some attractive compensations for them as well as for the secretaries. The originators can dictate whenever they wish, obtaining a second, third or fourth clean draft without fear of antagonizing the typist. And the secretaries have greater choice as to the type of work they do, as well as more opportunities for advancement. Instead of rising or falling with one executive on the corporate ladder as private secretaries do, they can choose among various career paths.

Those who prefer to be full-time typists do not also have to answer the telephone or make coffee. Because of the complexity of their equipment, they compete against their peers on the basis of technical proficiency, like the keyboarders (largely male) in the printing and publishing industry.

The administrative support personnel can choose to specialize in reception, research, scheduling and a variety of other activities that can lead into lower management positions and on up the ladder.

The market for word processors is growing rapidly. According to Purchase, there were 200,000 such machines in use in the U.S. at the end of 1974, and he expects the number to double in 2 to 3 years. By 1980, he estimates, 10 to 15 percent of the typewriters used in business will be word processors.

A number of companies have entered the word-processing market recently. In addition to IBM, there are more than a dozen other word processing typewriter manufacturers, including Xerox, which introduced its initial product in October 1974. And other office machines, such as copiers, dictation equipment and communication systems (including the telephone), are all being changed to make them a part of this market. Even furniture manufacturers have become word processing experts, offering to realign office floor space in order to utilize these new products and office systems with maximum efficiency.

In the next two to three years, Humphrey says, he expects this activity to lead to major changes in both equipment design

and office procedures. He points out that the recent drop in the cost of electronic components makes it reasonable to think of replacing the word processing typewriter with an assembly of electronic components (keyboards, printers, and electronic display screens), tied together by a microprocessor or minicomputer. Such an assembly is potentially more productive than the word processing typewriter, he notes, because the various functions of keyboarding, printing and display can be going on at the same time. With a typewriter, the keyboard, for example, is idle while automatic typing is in progress.

To justify the cost of such an assembly today, Humphrey estimates that the work load would have to be large enough for 4 to 8 word processing typewriters. But he notes that the cost of electronic components is dropping relative to that of the word processing typewriter. By 1978, he believes, an assembly of such components will be fully cost competitive on a one to one basis with the word processing typewriter.

Tomorrow's typist

There are of course many possible views of tomorrow's office. Humphrey's is as follows: He visualizes a word processing department in which each typist's desk would have a small, attractively designed keyboard with an electronic screen capable of displaying the last few lines of text.

In this computerized word processing system manufactured by *Vydec*, each typist has a large enough screen to display an entire page of text.

The typists would not have to hit the carriage return at the end of each line. Instead the machine would break the lines automatically. And there would be no paper to change. To make minor corrections as they typed, the typists would refer to the small display. For more extensive text editing after keyboarding, they could view a page at a time on a TV-type screen shared with one or more of their associates. To make a correction, the typist would merely point (with an electronic pointer) to the desired spot on the screen, type in the new words, and the corrected page would appear immediately on the screen.

For producing final copy after the corrections had been made, several typists might share a high-speed but relatively quiet printer, a phototypesetter or even the office copier.

Humphrey estimates that his system could improve productivity as much as 20 to 30 percent over a word processing typewriter. A major factor in this savings would be the increase in the typist's speed resulting from the elimination of paper. The carriage return, changing of paper and the noise of mechanical printing all tend to slow the typist down.

Another factor that would contribute to this potential savings is the greater ease and speed of editing. Experiments have shown that a skilled operator can edit a document 1-1/2 to 3 times faster on a good electronic display than on a word processing typewriter.

Clearly a cluster of word processing keyboards, display screens, memory and print mechanisms could be interconnected by telecommunications so that the units could be separated by long distances. This would allow mail to be sent by telephone lines from one company to another, just as data is sent today. Instead of preparing a final copy of a letter or document and stuffing it in the mail, the secretary would feed the magnetic recording into a device that would convert the information into a form that could be transmitted over the telephone lines. When it had arrived at the desired destination, the information would be printed out in hard copy or viewed on a screen.

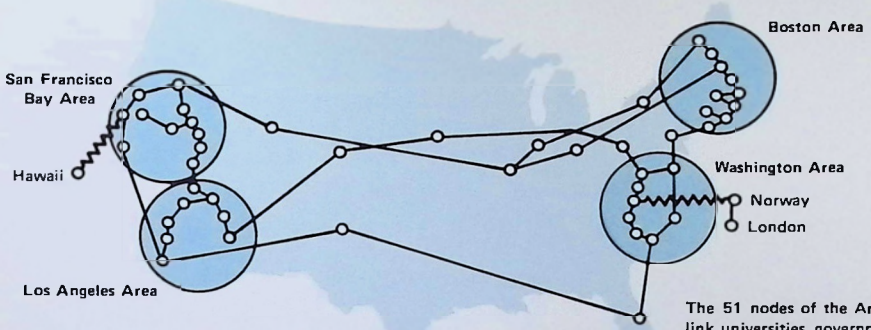
Better tax collecting

The Internal Revenue Service is experimenting with such a system to prepare and transmit briefs in tax cases from local IRS offices to Washington, D.C., where a word processing typewriter at the IRS headquarters types up a final document for review and filing.

This telecommunications capability makes it economically feasible to add to the system large but physically remote computers that are capable of more complex specialized functions such as phototypesetting, storage of boiler plate or longer text editing jobs — such as the updating of mailing lists.

Service bureaus specializing in such services have already sprung up in a few of the larger metropolitan areas. Their typical customer has one or more word processing typewriters inhouse that he uses as stand-alone devices to prepare routine correspondence and short documents and connects by telephone lines to the service bureau computer for more complex operations.

Purchase expects this trend to grow rapidly. By the 1980s he believes enough communications typewriters will be in use to have an important impact on business correspondence.



The 51 nodes of the Arpanet shown here link universities, government organizations and private companies in a single network of computers and terminals.

Largely responsible for this growth, he believes, will be cheaper and faster hardware and lower data communications costs. As postal rates go up, he says, high-volume data communications rates will become increasingly attractive. He explains it this way:

Business rates go down

Until recently, the rates set by the Federal Communications Commission (FCC) and the Bell System were based on service usage. Thus a rural or residential user who used the telephone only occasionally paid much less in relation to the actual cost of the service than did a heavy business user in a metropolitan area. But when the FCC permitted specialized common carriers, such as MCI, Datran and Southern Pacific to compete with the Bell System in high-use metropolitan corridors, the basis for the rates began to shift from use to actual cost of the service. Purchase sees a continuation of this trend, with the result that businesses will pay proportionately less for service while rural and residential users will pay more.

Computers interact

Another factor that will encourage more extensive communications with remote computers is the development of software to facilitate the interaction between different computer systems. Normally two systems, such as a large computer and a small one, or two different programs even in the same computer, have different data structures and formats and use different computer languages. Thus if a system designer, for example, wants to go from one time sharing program to another to help him design a particular system — like a carpenter going from one tool to another in the course of building a chair — he may have to use different computer languages with each program.

SRI has been one of the principal pioneers in developing the standards, data formatting and translation systems needed to eliminate this Tower of Babel. For 12 years, Douglas Engelbart, Director of SRI's Augmentation Research Center, and his colleagues have been developing a computerized "workshop" to augment the capabilities of professional workers. (See pp. 6-10 for details.)

Having developed a prototype coordinated workshop suitable for individuals and project teams, the researchers extended it to include a network-coupled distributed community when the ARPANET became available.

ARPANET users who have access to these tools can interact freely with computer installations anywhere on the net, provided they have made contractual arrangements with the host organizations. Thus they can easily move from one remote computer program to another in the course of carrying out their work assignments.

Several hundred people at SRI and elsewhere on the ARPANET are now using these facilities in the ways mentioned in the introduction and described more fully in the following pages.

This ease of interaction with remote computers may soon be available to business users generally. Recently two commercial spinoffs of the ARPANET — Telenet, a subsidiary of Bolt, Beranek and Newman, and Packet Communications, Inc. (PCI) — obtained FCC approval to build public networks similar to the ARPANET that will allow different types of computer systems located wide distances apart to send and receive messages from each other.

Telenet has completed its first switching center in Washington, D.C., and, according to Stuart Mathison, Vice President of Planning, the company expects to have similar centers in 7 major cities by mid 1975. Present plans call for 18 centers by early 1976, he says.

PCI hopes to have service in 18 cities by late 1975 or early 1976, according to its president, Lee Talbert.

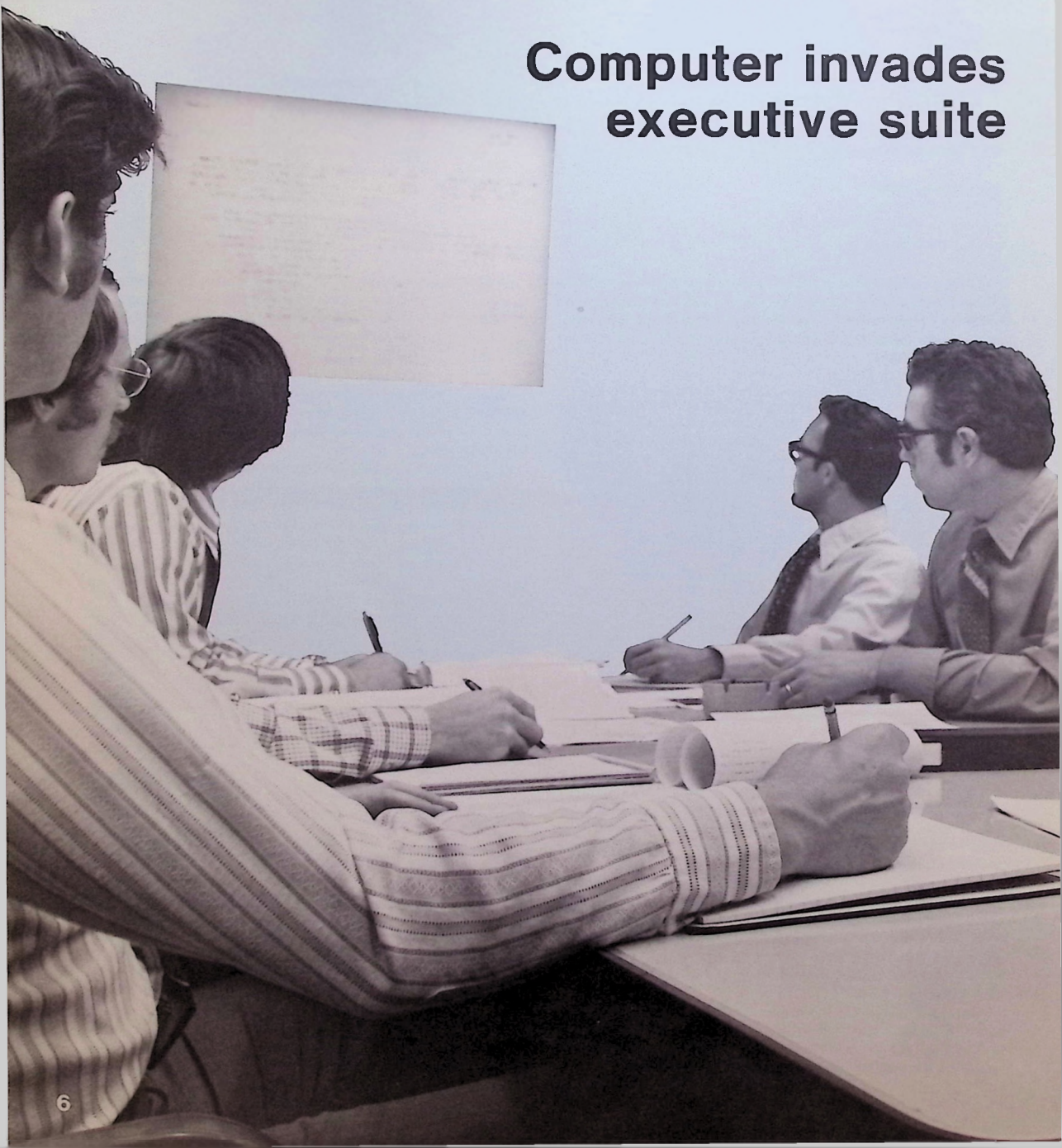
Cost independent of distance

Both companies propose to use "packet switching," a technology pioneered on the ARPANET. In this form of communication, messages are cut into pieces or "packets" of a given length. Each packet is then switched independently from one node of the network to the next along the best available route by means of switching computers at each node. When all the pieces arrive at their destination, a computer there reassembles the message and delivers it to the appropriate computer installation or terminal.

This switching technology is apparently low enough in cost to make a distance-independent rate structure economically feasible. Both Telenet and PCI have proposed to charge only by the length of the message and not by the distance it is sent.

The repercussions of this type of service and rate structure on the business world are likely to be profound. Some of the probable effects are described in the following pages. ■

Computer invades executive suite



Before long the computer revolution may extend beyond secretaries and other support personnel to the professionals they serve, profoundly influencing the working habits of every office employee.

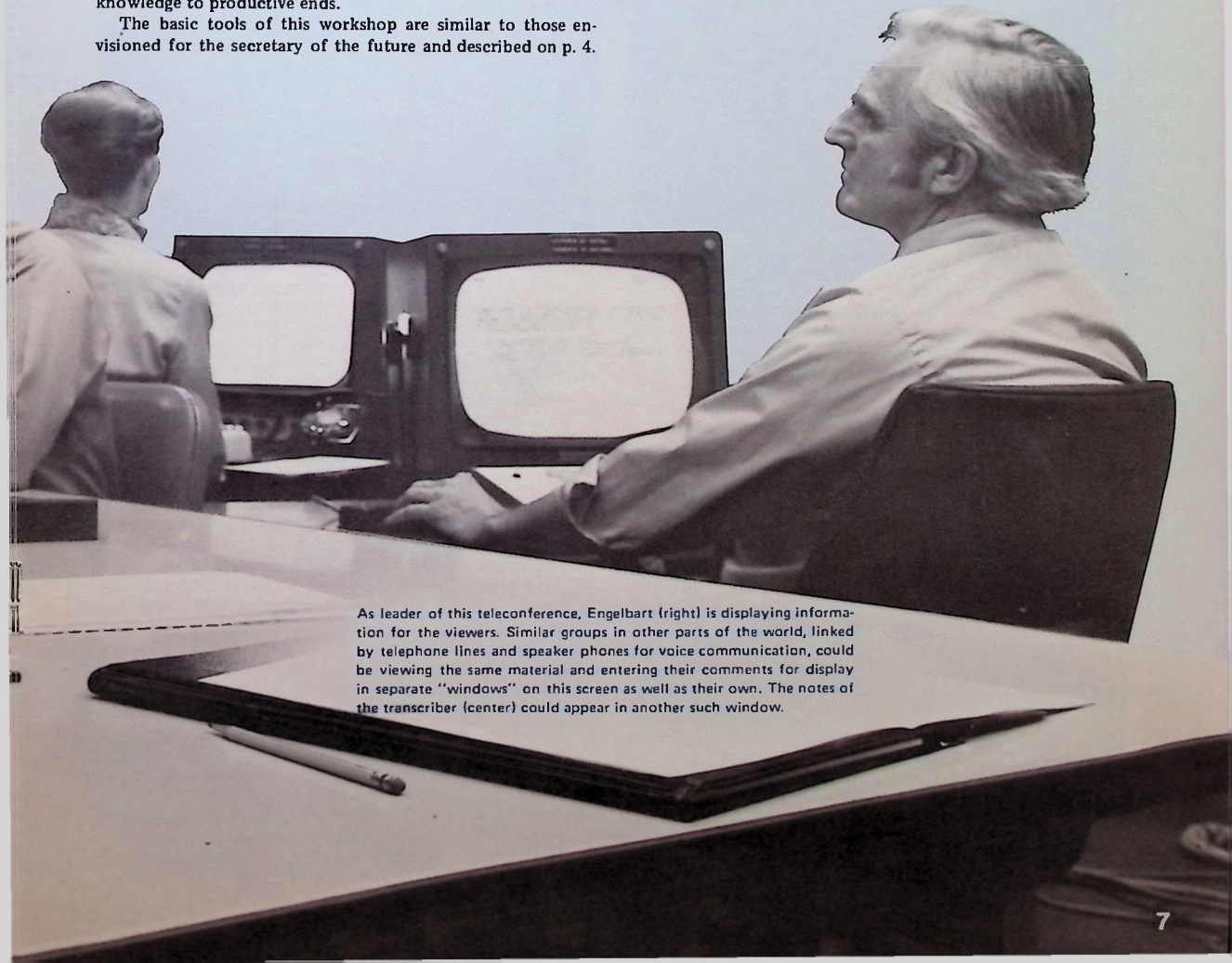
For 12 years, Douglas Engelbart, Director of SRI's Augmentation Research Center, and his colleagues have been developing a prototype coordinated "workshop" of computer tools to augment the capabilities of professional workers in the same way that drills, lathes, grinders and milling machines augment the capabilities of machinists.

The professionals whose capabilities Engelbart seeks to augment include all those whom Peter Drucker refers to as "knowledge workers" — that is, executives, planners, researchers, designers, writers and others who create and apply knowledge to productive ends.

The basic tools of this workshop are similar to those envisioned for the secretary of the future and described on p. 4. In fact, Engelbart intends his system to serve the secretary as well as the boss and all his colleagues and assistants.

The *visible* tools include an electronic screen and a typewriter keyboard, plus two additional hand controls. One is a tracking instrument, which he calls a "mouse," used to point to a spot on the screen and make simple commands to the computer. The other is a 5-finger keyset to supplement the typewriter-like keyboard for higher speed execution of detailed operations. (See figures on p. 8.)

The *invisible* tools of the workshop include all the computer hardware, software and communication networks needed to serve the daily handling of the users' working information — their notes, things-to-do lists, memos, letters,



As leader of this teleconference, Engelbart (right) is displaying information for the viewers. Similar groups in other parts of the world, linked by telephone lines and speaker phones for voice communication, could be viewing the same material and entering their comments for display in separate "windows" on this screen as well as their own. The notes of the transcriber (center) could appear in another such window.

designs, plans, budgets, announcements, commentary, proposals, reports, programs, documentary, item-control catalogs, etc.

These tools are linked together in a flexible modular format that makes it easy to add new tools as they become available or needed and to link the system with other computer research centers in the ARPANET. This is a computer network that was built under the sponsorship of the Advanced Research Projects Agency (ARPA) of the Department of Defense and interconnects computers all over the world into a single network.

Here Engelbart is accessing the Knowledge Workshop from a computer terminal in his office. By moving the "mouse" (in his right hand) over a circular area right of the keyboard, he can position a pointer anywhere on the screen. By pushing 1 or more of 3 buttons on top of the mouse, he can confirm or modify commands and short strings of text entered via the 5-finger keyset in his left hand. The bulk of the text he types on the keyboard. Displayed on the screen are 2 windows showing different views of the document he is composing. One window might display all the paragraph heads, for example, while the other displayed one particular paragraph. Up to 8 such windows could be displayed at a time.

A standard terminal such as this *Lear Siegler* display (shown also on the cover) can be used to access the Knowledge Workshop when the modular unit at the rear left is part of the system. Note "mouse" at right of terminal and 5-finger keyset at left.

The individual worker can use the workshop to draft and send memos, letters, documents, etc. The system then gathers together such material from all the members of an entire project team (who may be distributed throughout the country or even the world and connected only by the ARPANET), and organizes this material into a comprehensive data base or library. All the collaborative dialog that takes place among the team members over a period of months or years may be included in this library.

The tools of the Knowledge Workshop need not be the latest state of the art in computer keyboards and display screens. A standard teletypewriter (left) can pinch-hit for both. Here a typist is entering a report on the teletypewriter for storage on tape cassette (right). The text will be read into the computer during off hours, leaving prime computer time open for editing, composing and information management.

By a simple command to his own deskside terminal, each team member can call up any part of this dialog on his screen, modify it, make notes in the margin, index it, send it to another team member, or cross reference it in a memo of his own.

When the recipient of the memo comes across that reference in the memo, he can command the computer to change the display quickly to show the item referenced in whole or in part, and then return to the memo. Or he can divide his display into separate windows so that he can view each simultaneously.

The helicopter view

The system allows the user to scan through messages and reports in a variety of ways. For example, he can command it to display just the chapter titles or just the main paragraphs. He can then point at items in the middle of this list and make the computer show some sublist such as the first sentence or the first two sentences of each paragraph. Or if he instructs the computer to "jump to content," he can then type in a phrase or a word and the computer will show him where that phrase appears in the report and what words appear immediately before and after it.

This *Data Products* line printer produces "hard" or paper copy of any material in computer memory at the rate of 6 standard letter-size pages per minute.

James C. Norton, Assistant Director of the Augmentation Research Center, points out that these sophisticated tools actually change the way users think.

Typically, he says, writers who have never used the system organize at most the main points of a document, letting their thoughts on each point flow freely and sending the result to the typist. Not surprisingly, they often continue to make changes up to and including costly final stages of production.

The workshop tools allow users to rearrange words and paragraphs easily, so they can organize the material as they go along, trying this paragraph up there, noting the effect and changing it back if need be. Often when they look at the structure of the draft in some of the new ways described above, areas of faulty organization pop out at them.

When the report is completed to their satisfaction, they can have it printed out or even published in final form. Programs that control these operations are included in the workshop software.

In addition, the worker can use other programs not presently included in the workshop so long as they are available on the ARPANET and provided, of course, that he makes contractual arrangements with the owners of the programs. He might, for example, wish to work interactively with a program that would help him step by step in the preparation of drawings and other graphics for the report. Once he had the entry code, he could access such a remote program as easily as one included in the workshop.

Richard W. Watson, another assistant director of the Center, points out that for him and many other ARPANET users, their deskside computer terminals have largely replaced the U.S. mails. To send a message to a colleague anywhere on the ARPANET, Watson types the recipient's name and organization into the keyboard and follows with the message. This information is stored in his or the addressee's computer memory. The next time the addressee logs in at his terminal, he sees Watson's name and the subject of the memo displayed on his screen, along with all his other messages. If the message is urgent, Watson can instruct the computer to notify the recipient as soon as the message is delivered by putting a special flag on the recipient's screen.

Watson admits that he finds this system of communication preferable even to the telephone.

"I don't have to wait while the operator places the call," he explains, "or worry about time differences. And I don't have to interrupt the recipient. I know he will be logging in 3 or 4 times a day, so I can probably count on a response the same day."

Computerized in-basket

One of the programs developed by the Center sorts Watson's mail for him, so that instead of reading through all the messages on the screen, he can query the computer about the nature of the messages. For example, he can ask it how many messages he has received, who they are from, whether they are over or under a certain length, etc. Then he can scan through the messages selectively in the manner described above for documents generally.

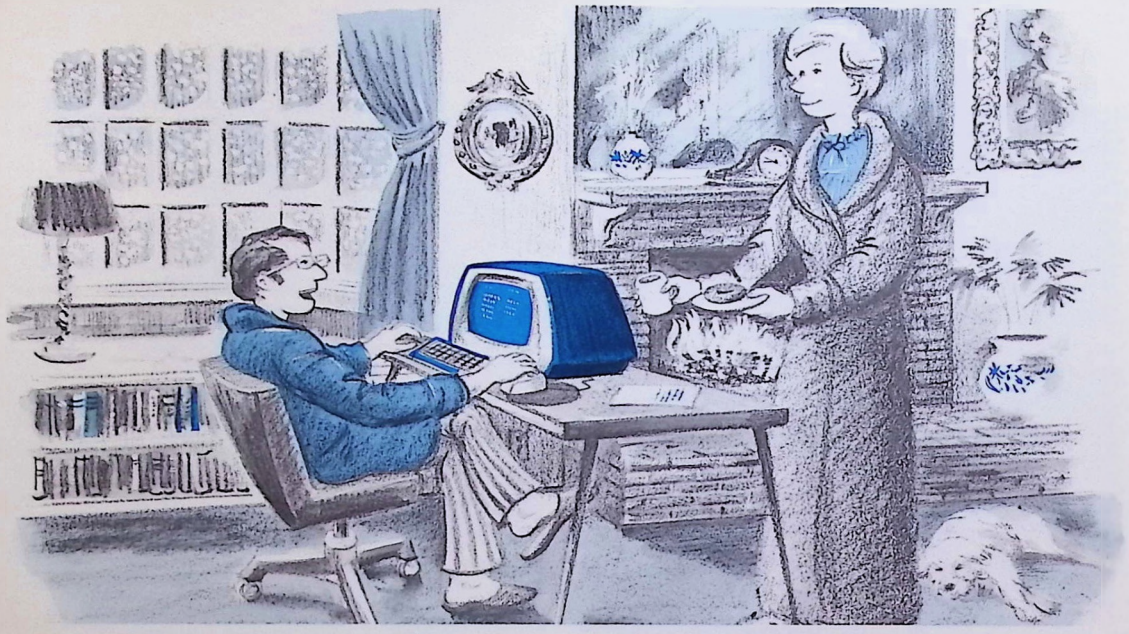
The availability of these computer tools on the ARPANET (and SRI is making them available on an experimental basis to clients) encourages collaboration among workers in different branches of an organization or in different organizations involved in the same project. Not only can they send messages to each other, but they can set up conferences in two or more locations so that groups can interact. This is of course a great saving in time and energy over physically traveling to a common conference room. Large display screens in each conference room (or smaller ones beside each attendee, or both) can be linked so that an operator in any of the rooms (or each attendee himself) can control the visual material that is viewed simultaneously on all screens. This capability can be combined with two-way voice contact, such as the speaker phone, or video.

A computerized marketplace

The implications of these capabilities for the business world in the last years of this century are obviously profound — as profound Engelbart believes, as the effects of railroads on the cottage industries of the 19th Century. At one time, he notes, every town had its artisans who supplied it with products that today are made at centralized factories and shipped throughout the world.

Engelbart expects a new computerized "marketplace" to evolve that will represent "fantastic wealth in the commodities of knowledge, service, information, processing, storage, etc. In the number and range of transactions, and in the speed and flexibility with which they are negotiated," he says, "this new market will have a vitality and dynamism as much greater than today's as today's is greater than the village market."

This computerized marketplace will encourage specialization, he believes. Some individuals or small groups will provide libraries of information, all arranged for convenient use. Others will offer interactive programs specially tailored for particular types of analyses or for doing the text-graphic document typography in a special area of technical portrayal.



"What! Coffee time already?"

"Let's look at a specific 'for instance,'" says Engelbart. "Suppose that one person becomes extremely proficient in making small programs to generate a display or printout to show (particularly well) the status of a multi-task project. He is an independent agent in this multi-access computer network, working at a display console in his office at home. Perhaps he specializes in construction projects, and within this, perhaps, in steelwork erection.

"You are a management consultant working (from your home) on a short job helping to set up the production-control system for a construction project. When you realize that you might benefit from this kind of help, this is the sequence that takes place:

"Your man is easy enough to find because of computer help in searching for and evaluating special products and services. Suppose you need something he can do for you with about 45 minutes' effort. You expect immediate accessibility for negotiation. For instance: It takes you one minute to locate several candidates, two minutes to examine their relative credentials, 20 seconds' interrogation of public records to select him as being available right now for your kind of problem, two minutes of personal dialog to determine for both of you that his capabilities and your needs match, and 15 seconds to negotiate and legalize a contract. He does his job in 40 minutes, and spends five more minutes transferring the results to you (with dialog).

Time share a client

"He switches back immediately to a task sequence whose contract arrangement had permitted him such interruptions. In working on this job, you have been 'time-shared' with several other jobs having higher priority, and several that were running 'background.' During the forty minutes he was off doing his thing for you, your higher-priority task sequences took you off on other pursuits. In fact, when he was done, you weren't ready to get back to him for twenty-three minutes, but the mutual-scheduling algorithm agreed upon in your contract took care of connecting you and him, when you were both ready for your final dialog."

21st century middlemen

Obviously there will have to be brokers, wholesalers, middlemen, retailers and bankers to make this computerized marketplace a working reality. And there will be a need for procedures and systems to assure privacy. (See, for example, "Profile of a Computer Criminal, INVESTMENTS in TOMORROW, Spring 1973.)

But Stuart Mathison, Vice President of Planning for Telenet, which is constructing a commercial network similar to the ARPANET, points out that long before all the mechanics of a computer marketplace can be worked out, there will be many uses for a commercial net. He expects the Telenet to be particularly attractive for interactive modes of communication with the computer — such applications as timesharing and order entry or credit checking at the point of sale. It will also be attractive, he believes, for batch processing — the transmission of continuous streams of information such as large files on tape or cards — but only for long distances. For distances under about 500 to 1000 miles, he says, the leased line will probably be more economic than the Telenet for the next few years. ■

INVESTMENTS in TOMORROW
Winter 1975 Issue No. 14

INVESTMENTS in TOMORROW is published four times a year by Stanford Research Institute, Menlo Park, Ca. Subscriptions are available at no cost to qualified subscribers. Correspondence should be addressed to Editor, **INVESTMENTS in TOMORROW**, 3333 Ravenswood Avenue, Menlo Park, Ca. 94025. Articles in this magazine may be reprinted without special permission.

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Cover photo: *Lear Siegler* display terminal

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